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Electrification and Hydrogen – identifying the technology solution for decarbonising the UK’s road freight fleet

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Executive Summary

The UK has announced ambitious but feasible end of sale dates for all new non-zero emission vehicles with 2040 as a backstop [1]. There are multiple technologies capable of delivering zero-emissions for the heaviest vehicles (typically 40-44 tonnes), but it is likely that hydrogen fuel cells will play an important role alongside mass electrification. However, industry frequently report that uncertainty remains about which technology to invest in due to a lack of real-world data. This poses a real risk of holding back investment in the recharging and refueling infrastructure needed to support the transition to a fully zero emission transport future.

UK’s Zero Emission Road Freight Demonstrator (ZERFD) programme aims to address this by identifying the technology mix that is best suited for the UK market through at-scale, on road commercial demonstrations of the competing powertrains. This will ensure that vital infrastructure investments can begin at pace. This is the largest comparative study of these zero emission technologies announced anywhere in the world.

Keywords: *Battery electric vehicle (BEV), demonstration, fuel cell vehicle, infrastructure, truck*

1 Introduction

The UK has committed to ending the sale of all new non-zero emission heavy goods vehicles (HGVs) weighing 26 tonnes and less by 2035, and that all new HGVs sold in the UK must be zero emission by 2040. In due course, as with cars and vans, the UK will need to adapt its regulatory framework to ensure that the phase out dates for HGVs can be brought into legal effect. Consultation on what this future regulation may look like and how it may impact the sector will take place in due course.

Whilst the announced end of sales sets a clear destination for decarbonising the UK’s road freight fleet, there remain uncertainties that need to be resolved to ensure that these dates can be achieved. Primary amongst these is how infrastructure will be deployed, and linked to this, which technology solution is best suited to decarbonising the heaviest road freight vehicles within the UK context. Both questions will need to be answered to enable infrastructure investment decisions to be made by both the private and public sectors.

Existing equipment appears to support the use of battery electric technology for the decarbonisation of the majority of vehicle use cases for HGVs weighing 26 tonnes and under (typically ‘rigid’ vehicles); this appears to be the clear and rapid direction of travel within the market. There may be niche applications in this weight

category where hydrogen fuel cells may be better suited, for use in remote locations or where faster refuelling times are demanded.

A challenge is decarbonising the heaviest vehicles (ones weighing 40-44 tonnes and typically ‘articulated’). Multiple technologies are capable of this with the dominant technologies being battery electric and hydrogen fuel cell. Whilst these technologies have all been proven to work as part of small-scale international trials, none have been comparatively demonstrated at-scale (i.e. hundreds of vehicles) anywhere in the world to produce an evidence base on which technology mix may be best suited for specific use cases.

To address this ZERFD will demonstrate both at scale, building an evidence base to inform future investment decisions not only in the UK, but elsewhere in the world and provide confidence to ramp up investments.

1.1 Background

As part of its Net Zero Strategy [2], the UK committed to demonstrating multiple zero emission HGV technologies at scale on UK roads to determine their operational benefits, as well as this infrastructure needs. This is against the backdrop of the UK’s stated position of technology neutrality – the UK has set ambitious targets but have no pre-conceived technology preference for how they are achieved.

Heavy goods vehicles were the source of 19% [3] of UK domestic greenhouse gas (GHG) emissions in 2020 and are set to become a greater proportion of domestic GHGs as other areas of the economy continue to or begin to decarbonise. To support the uptake of new zero emission HGVs, associated infrastructure will need to be deployed at pace. The mix of infrastructure required will be clear by the latter half of this decade (2025-2027) ensuring that sufficient infrastructure is deployed to meet the UK’s announced end of sale dates.

Whilst battery electric or hydrogen fuel cell technologies are vital to deploy in the 40-44 tonne weight category in the medium-term, legacy HGV fleets could benefit from low carbon fuel deployment today. HGV fleets with depot-based refuelling, particularly in logistics, construction, haulage, and quarry industry fleets which are hard to decarbonise in the short- and medium-term, can benefit from low carbon fuels. This will be an interim measure before zero emission technologies can be deployed at scale.

2. Scope of the ZERFD programme

The programme will kick-start at-scale deployment of zero emission long haul road freight and its supporting infrastructure within the UK. It will also provide confidence and clarity to the sector that these vehicles can replicate the duty cycles of existing diesel vehicles. In partnership with consortia made up of vehicle manufacturers, fleet operators, businesses, energy providers and chargepoint and refuelling providers, the programme will deploy large scale demonstrations of the technologies on UK roads. It will feature the running of normal commercial routes to gather evidence on the benefits and challenges of both technologies and their accompanying infrastructure. Crucially, UK supply chains in each of the technologies will be developing at same time. The programme will seek to break down barriers to adoption of the technologies and will seek to allow the UK to identify the best technology, or combination, to replace diesel HGVs on UK roads.

The technologies being demonstrated as part of the programme have been chosen based on learnings from previous programmes, including the UK’s Low Emission Freight Trials (LEFT). They have also been determined through examination of international comparators, through international engagement on future years plans, and through extensive stakeholder engagement, both as part of the Zero Emission Road Freight Trial (ZERFT) programme (2021/22) and as part of the recent consultations on phasing out the sale of new non-zero-emission HGVs within the UK. The technologies forming the demonstrations have also been recommended by the Climate Change Committee – independent advisors to UK Government.

One of the leading principles behind determining the UK’s end of sale dates for new non-zero emission HGVs was that that all vehicles sold beyond these dates should produce zero emissions at the exhaust, including GHG and pollutant emissions [4]. Emissions which do not damage public health, such as water vapour, are permitted. Given this definition of ‘zero emissions’, and that the ZERFD programme was designed to determine which technology solution would be best suited for this decarbonised future, several technologies were ruled out for inclusion within the ZERFD programme. These include low carbon fuels such as

biomethane and ammonia. In addition, hydrogen combustion technologies have also been ruled because at present all internal combustion engines produce harmful exhaust emissions and would therefore be subject to the end of sale dates. Should technology developments enable renewable hydrogen to be used in combustion engines that produce zero harmful exhaust emissions, then this would be re-examined. The demonstrations will provide evidence for any regulatory and planning issues which may need to be resolved in advance of any future wide-scale infrastructure roll-out. The evidence base developed by the programme will be used to inform future policy and investment decisions, both within Government, and in the private sector. This evidence base will be made publicly available, and it is believed that it will provide a useful source of information to inform and influence similar decisions being taken in other countries.

It is vitally important that as the UK transitions to a zero emission road freight fleet, the technology choices and associated vehicle and infrastructure standards remain compatible with the rest of Europe to ensure the continuity of seamless cross-border freight.

The programme will fund hundreds of zero emission HGVs and their accompanying refuelling or recharging infrastructure. All capital elements (vehicles and infrastructure) will be in place by March 2025. This will be followed by a five-year demonstration period when the real-world data will be collected and disseminated. It is expected that national infrastructure decisions can start to be made by the middle of this decade (2025-2027) based on evidence collected and disseminated during the build and initial demonstration phases.

This mass scale zero emission HV demonstrator programme will:

- i. Create an evidence base on which technology (or technology mix) is best suited to decarbonise the UK's heaviest road freight vehicles (40-44t trucks) based on its real-world operating performance in UK fleets.
- ii. Grow confidence in the sector to encourage long-term investment planning and decision making.
- iii. Provide an understanding of the future infrastructure needs and approach to deployment.
- iv. Support the transition to a fully zero emission fleet of HGVs in the UK.
- v. Identify potential standards and regulation which may present barriers to the uptake of zero emission HGVs.

3. Current position

Following the conclusion of the competitions for the battery electric and hydrogen fuel cell elements of the programme in October 2022, the Department will be making announcements on the winning projects focusing on battery electric and hydrogen fuel cell technology strands. While the UK Government is not yet able to confirm the winning consortia bids, it is likely that they will see deployment of hundreds of battery electric HGVs and more than two hundred battery electric chargers across over a dozen locations in England. The UK Government expects this to be a good mix of depot based and publicly available charging, for example those located at motorway service areas. This will be a mix of megawatt chargers and smaller ones to service a range of user needs.

For hydrogen this is likely to see a good range of vehicles, potentially including specialised vehicles such as refrigerated ones. These will be accompanied by fixed and mobile refuelling infrastructure which will also have a mix of closed and open access truck stops with chargers ranging from 1MW to 150kw.

Work is underway across the Department to align infrastructure deployment with other decarbonisation programmes within the UK to create synergies and rationalise infrastructure deployment to ensure value for money.

4. Next steps

Once the announcements of winning consortia partners are announced, they will undertake detailed planning. Their work will also focus on procuring vehicles and infrastructure, both likely to be in place by March 2025. The demonstrations will then continue until March 2030 at the latest.

References

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Presenter Biography



Nick has been Joint Head of the Office for Zero Emission Vehicles since July 2022, leading the UK government team supporting the transition to zero emission vehicles and the rollout of charging infrastructure. Prior to this, he was Deputy Head of Decarbonisation Strategy in the Department for Transport (DfT), including developing the 2021 Transport Decarbonisation Plan. Before DfT, he worked in Cabinet Office covering energy, environment and transport, and the Department of Energy and Climate Change.